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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/942,419	08/30/2001	Stephen E. Fischer	FIS920010195US1	7375
7590	01/14/2005		EXAMINER	
McGuire Woods LLP Suite1800 1750 Tysons Boulevard McLean, VA 22102			FERRIS III, FRED O	
			ART UNIT	PAPER NUMBER
			2128	

DATE MAILED: 01/14/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	09/942,419	FISCHER ET AL.	
	Examiner	Art Unit	
	Fred Ferris	2128	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) Responsive to communication(s) filed on 30 August 2001.
- 2a) This action is FINAL. 2b) This action is non-final.
- 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) Claim(s) 1-20 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) Claim(s) _____ is/are allowed.
- 6) Claim(s) 1-20 is/are rejected.
- 7) Claim(s) _____ is/are objected to.
- 8) Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) The specification is objected to by the Examiner.
- 10) The drawing(s) filed on 30 August 2001 is/are: a) accepted or b) objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 - a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. _____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>11/27/01</u> . | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

1. *Claims 1-20 have been presented for examination based on applicant's disclosure filed on 30 August 2001. Claims 1-20 have been rejected by the examiner.*

Drawings

2. *The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the must be shown or the features canceled from the claims. No new matter should be entered.*

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. The replacement sheet(s) should be labeled "Replacement Sheet" in the page header (as per 37 CFR 1.84(c)) so as not to obstruct any portion of the drawing figures. If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

MPEP Section 608.02(d) [R-2] "Complete Illustration in Drawings" recites the following:

"37 CFR 1.83. Content of drawing.

(a) *The drawing in a nonprovisional application must show every feature of the invention specified in the claims. However, conventional features disclosed in the description and claims, where their detailed illustration is not essential for a proper understanding of the invention, should be illustrated in the drawing in the form of a graphical drawing symbol or a labeled representation"*

In this case, none of the drawings (Figs. 1-6) show elements or features of the tetrahedralization filter comprising a receiver, a processor, and an element subdivider recited in independent claim 14. While figure 6 (block 132) shows a

tetrahedralization filter, none of the figures show the claimed elements relating to the receiver, a processor, or element subdivider.

Claim Rejections - 35 USC § 101

35 U.S.C. 101 reads as follows:

Whoever invents or discovers any new and useful process, machine, manufacture, or composition of matter, or any new and useful improvement thereof, may obtain a patent therefor, subject to the conditions and requirements of this title.

3. *Claims 1-20 are rejected under 35 U.S.C. 101 because the claimed invention is drawn to non-statutory subject matter.*

Specifically, claims 1-20 are not technologically embodied since the claims have not recited any limitations relating to a practical application in the technological arts and have merely claimed a manipulation of abstract ideas (tetrahedralization - mathematical constructs) and non-functional descriptive material (dynamic directory) which are not tangibly embodied.

Specifically, independent claim 1 recites a dynamic directory that is not tangibly embodied (i.e. no hardware) while independent claims 3, 14, and 19 recite tetrahedralization (i.e. mathematical abstract ideas) by abstract steps performed without hardware. (Independent claim 14 recites a tetrahedralization filter but the disclosure does not reveal how the filter is realized, see 112(1) rejection below). The Examiner therefore submits that Applicant's have not recited any limitations that provide a tangible result and have merely claimed a manipulation of abstract ideas realized as mathematical constructs that are not tangibly embodied. Section 2106 [R-2] (Patentable Subject Matter — Computer-Related Inventions) of the MPEP recites the following:

"In practical terms, claims define nonstatutory processes if they:

- consist solely of mathematical operations without some claimed practical application (i.e., executing a "mathematical algorithm"); or
- **simply manipulate abstract ideas**, e.g., a bid (*Schrader*, 22 F.3d at 293-94, 30 USPQ2d at 1458-59) or a bubble hierarchy (*Warmerdam*, 33 F.3d at 1360, 31 USPQ2d at 1759), **without some claimed practical application.**"

An invention which is eligible for patenting under 35 U.S.C. § 101 is in the "useful arts" when it is a machine, manufacture, process or composition of matter, which produces a concrete, tangible, and useful result. The fundamental test for patent eligibility is thus to determine whether the claimed invention produces a "**useful, concrete and tangible result.**" The test for practical application as applied by the examiner involves the determination of the following factors:

(1) "Useful" - The Supreme Court in *Diamond v. Diehr* requires that the examiner look at the claimed invention as a whole and compare any asserted utility with the claimed invention to determine whether the asserted utility is accomplished.

(2) "Tangible" - Applying *In re Warmerdam*, 33 F.3d 1354, 31 USPQ2d 1754 (Fed. Cir. 1994), the examiner will determine whether there is simply a mathematical construct claimed, such as a disembodied data structure and method of making it. If so, the claim involves no more than a manipulation of an abstract idea and therefore, is nonstatutory under 35 U.S.C. § 101. In *Warmerdam* the abstract idea of a data structure became capable of producing a useful result when it was fixed in a tangible medium which enabled its functionality to be realized.

(3) "Concrete" - Another consideration is whether the invention produces a "concrete" result. Usually, this question arises when a result cannot be assured. An appropriate rejection under 35 U.S.C. § 101 should be accompanied by a lack of

enablement rejection, because the invention cannot operate as intended without undue experimentation.

The Examiner respectfully submits, under current PTO practice, that the claimed invention does not recite either a useful, concrete, or tangible result and is merely drawn to a manipulation of abstract ideas (tetrahedralization) and non-functional descriptive material (dynamic directory).

- *The invention is not **useful** since independent claims 1, 6, and 11 do not recite a result that is useful in the technological art. This makes it difficult to determine Applicant's invention since it merely claims a manipulation of abstract ideas by tetrahedralization. (The patent eligibility standard requires **significant functionality to be present to satisfy the useful result aspect** of the practical application requirement. See *Arrhythmia*, 958 F.2d at 1057, 22 USPQ2d at 1036.)*
- *The claims are not **tangible** since, for example, the results of the "trade-off relationship between objection functions is undefined. No tangible result is recited as a result of performing the element subdivision.*
- *The claims are not **concrete** because the results are not assured. For example, is a solution possible for any and all arbitrary inputs? (i.e. any element subdivision?)*

Dependent claims 2, 4-13, 15-18, and 20 inherit the defect of the claims from which they depend.

Claim Rejections - 35 USC § 112

The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the

art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 14-18 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Specifically, independent claim 14 includes limitations relating to a tetrahedralization filter comprising a receiver, a processor, and an element subdivider for the mesh that have not been sufficiently disclosed in the specification. While the specification makes reference, for example, to data being entered into a tetrahedralization filter (page 13, line 24), there is no sufficient teaching that would allow a skilled artisan to realize the claimed receiver, processor, or element subdivider from the description given in the specification. There are no methods, or techniques disclosed for actually realizing the claimed receiver, processor, and element subdivider, in either hardware or software sufficient to allow one skilled in the art to make and use the claimed subject matter without undue experimentation. Figure 6, and the reference to the Data Explorer visualization program (page 13, line 29) do not cure this deficiency. The examiner therefore submits that the specification does not provide a clear and concise description of the subject matter claimed in independent claim 14.

Dependent claims 15-18 inherit the deficiency of the claims from which they depend.

5. Claims 1-2 are rejected under 35 U.S.C. 112, first paragraph, as based on a single means and are therefore nonenabling for the scope of the claim.

In accordance with MPEP section 2164.08(a) these claims are subject to an undue breadth rejection under 35 U.S.C. 112, first paragraph as reciting only a single means (step). MPEP § 2164.08(a) recites the following:

2164.08(a) Single Means Claim

A single means claim, i.e., where a means recitation does not appear in combination with another recited element of means, is subject to an undue breadth rejection under 35 U.S.C. 112, first paragraph. In re Hyatt, 708 F.2d 712, 714-715, 218 USPQ 195, 197 (Fed. Cir. 1983) (A single means claim which covered every conceivable means for achieving the stated purpose was held nonenabling for the scope of the claim because the specification disclosed at most only those means known to the inventor.). When claims depend on a recited property, a fact situation comparable to Hyatt is possible, where the claim covers every conceivable structure (means) for achieving the stated property (result) while the specification discloses at most only those known to the inventor.

In this case, independent claim 1 recites the phrase "A dynamic directory of degree of freedom data.... comprising:" but subsequently recites only the single means of "a respective degree of freedom value for each element, wherein, the degree of freedom value is current as element sub-division proceeds". This single means is nonenabling for the scope of the claim since it is not in combination with any additional means (steps) and, hence, can be interpreted as encompassing every conceivable means for achieving the claimed limitation. Dependent claim 2 inherits this defect.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

- (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and

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the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

6. Claims 1-2 are rejected under 35 U.S.C. 103(a) as being unpatentable over "Efficient Subdivision of Finite-Element Datasets into Consistent Tetrahedra", G. Albertelli, IEEE 0-8186-8262-0/97, IEEE 1997 (of record) in view of "Bounds on the Size of Tetrahedralizations", B. Chazelle et al, 10th Conference on Computational Geometry, ACM 1994.

Regarding independent claim 1: Albertelli teaches subdividing unstructured mesh elements inclusive of a non-conformal mixed element mesh which is sub-dividable into tetrahedral (Abstract, Sections 1, para: 1, Section 2, para: 3, 4, Section 3, para: 1-5, Figs. 3, 4).

Albertelli does not explicitly disclose minimizing Steiner points using a dynamic directory of degree of freedom value during tetrahedralization.

Chazelle teaches dynamically checking for the addition of Steiner points (pp. 231, para: 2-5, 235, para: 1) during tetrahedralization by reducing to the lowest value (one) for the degrees of freedom (DOF) (pp. 237, para: 2-3, Fig. 12). That is, the degree of freedom value in the teachings of Chazelle is always current as the element

subdivision proceeds. The use of a dynamic directory is well-known in the data processing and would have been an obvious choice for storing the degree of freedom (DOF) data. The examiner notes that the Microsoft Computer Dictionary defines a "dynamic directory" as merely a method of "organizing by stored tables of data that are updated in real time" (i.e. dynamically). Hence, a skilled artisan would have knowingly created a dynamic directory for the degree of freedom values during the mesh generation in order to efficiently track, store, and use the degree of freedom values during tetrahedralization.

It would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of Albertelli relating to subdividing unstructured mesh elements in a non-conformal mixed element mesh, with the teachings of Chazelle relating to dynamically checking for the addition of Steiner points and degree of freedom values, to realize the claimed invention. An obvious motivation exists since, as referenced in the prior art, additional Steiner points increase the mesh size and require additional computational power (See Chazelle, pp. 231, para: 2). Accordingly, a skilled having access to the teachings of Albertelli and Chazelle, would have knowingly modified the teachings of Albertelli with the teachings of Chazelle, in order to reduce the number of Steiner points in the mesh to provide a smaller and more efficiently processed mesh.

Per dependent claim 2: As noted above the Microsoft Computer Dictionary defines a "directory" as a method of "organizing by stored tables of data" that further includes a "topmost root directory" and "subdirectories" which are organized in various

ways including alphabetically, by date, by size, values etc. (See: Microsoft Computer Dictionary, third edition, 1997) Hence a skilled artisan would have knowingly organized the directory so the element subdivisions where ordered beginning with the low degree of freedom subdivision as a design choice (i.e. by size of the DOF value).

7. Claims 3-12 and 19-20 are rejected under 35 U.S.C. 103(a) as being unpatentable over “Efficient Subdivision of Finite-Element Datasets into Consistent Tetrahedra”, G. Albertelli, IEEE 0-8186-8262-0/97, IEEE 1997 (of record), in view of “Bounds on the Size of Tetrahedralizations”, B. Chazelle et al, 10th Conference on Computational Geometry, ACM 1994, and in further view of “Polyhedral modeling”, G. Bonneau, Proceedings Visualization ’00, IEEE 2000.

Regarding independent claims 3 and 19: As previously cited above, Albertelli teaches subdividing unstructured mesh elements inclusive of a non-conformal mixed element mesh which is sub-dividable into tetrahedral (Abstract, Sections 1, para: 1, Section 2, para: 3, 4, Section 3, para: 1-5, Figs. 3, 4).

Albertelli does not explicitly disclose minimizing Steiner points by identifying the degree of freedom value during tetrahedralization.

Chazelle teaches checking for the addition of Steiner points (pp. 231, para: 2-5, 235, para: 1) during Chazelle teaches checking for (identifying) the addition of Steiner points (pp. 231, para: 2-5, 235, para: 1) during tetrahedralization by reducing to the lowest value (one) for the degrees of freedom (DOF) (pp. 237, para: 2-3, Fig. 12) by

identifying to the lowest value (one) for the degrees of freedom (pp. 237, para: 2-3, Fig. 12).

It would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to modify the teachings of Albertelli relating to subdividing unstructured mesh elements in a non-conformal mixed element mesh, with the teachings of Chazelle relating to dynamically checking for the addition of Steiner points and degree of freedom values, to realize the claimed invention. An obvious motivation exists since, as referenced in the prior art, additional Steiner points increase the mesh size and require additional computational power (See Chazelle, pp. 231, para: 2). Accordingly, a skilled having access to the teachings of Albertelli and Chazelle, would have knowingly modified the teachings of Albertelli with the teachings of Chazelle, in order to reduce the number of Steiner points in the mesh to provide a smaller and more efficiently processed mesh.

Albertelli further does not explicitly disclose performing mesh element subdivision based on the degree of freedom values of the elements.

Bonneau teaches subdividing mesh elements based on the degree of freedom values of the elements. (pp. 382, Section 2.1, Fig. 1) That is, the subdivision process disclosed by Bonneau is based on the introduction of the degree of freedom value into the mesh patch. (Sections 2.2-3.4) The examiner interprets this process to be functionally equivalent to the claimed process of subdivision based on the degree of freedom value of the elements.

It would have been obvious to one of ordinary skill in the art at the time the claimed invention was made to further modify the teachings of Albertelli and Chazelle as noted above, with the teachings of Bonneau relating to subdividing mesh elements based on the degree of freedom value, to realize the claimed invention. An obvious motivation exists since, as noted above, additional Steiner points increase the mesh size and require additional computational power (See Chazelle, pp. 231, para: 2). That is, more Steiner points are problematic as noted by Chazelle. Accordingly, a skilled having access to the teachings of Albertelli, Chazelle, and Bonneau would have knowingly further modified the teachings of Albertelli and Chazelle with the teachings of Bonneau, in order to further reduce the number of Steiner points in the mesh to provide an even smaller and more efficiently processed mesh.

Per dependent claim 4: Albertelli teaches subdivisions based on most-constrained elements. (pp. 215, Section 5.0)

Per dependent claim 5: Albertelli discloses alternating/opposite subdivisions of faces (i.e. the subdivisions look ahead) (pp. 214, Section 3.0).

Per dependent claim 6: As noted by applicants on page 2, line 23 of the specification, Dompierre criteria is well known and hence would have knowingly been incorporated by a skilled artisan to subdivide elements into tetrahedral.

Per dependent claim 7: As noted above, a skilled artisan would have knowingly created a dynamic directory for the degree of freedom values during the mesh generation in order to efficiently track, store, and use the degree of freedom values during tetrahedralization. (See Chazelle, "directory" above)

Per dependent claims 8-10: This group of claims merely relates to updating the degree of freedom data. As noted above, the claimed "directory" for DOF data is a method of "organizing by stored tables of data" that further includes a "topmost root directory" and "subdirectories" which are organized in various ways including alphabetically, by date, by size, values etc. (See: Microsoft Computer Dictionary, third edition, 1997) Hence a skilled artisan would have knowingly updated the DOF directory after element subdivisions out of necessity in maintaining the DOF directory.

Per dependent claims 11-12: Breadth-first searching is a well-known search technique (See: "search techniques", Encyclopedia of Computer Science, first edition 1976) used in data processing and would have been knowingly incorporated by a skilled artisan using the reasoning previously cited above. Albertelli teaches subdivisions based on most-constrained elements (pp. 215, Section 5.0) as noted above.

Per dependent claim 20: As previously cited above, Chazelle teaches dynamically checking for the addition of Steiner points (pp. 231, para: 2-5, 235, para: 1) during tetrahedralization by reducing to the lowest value (one) for the degrees of freedom (DOF) (pp. 237, para: 2-3, Fig. 12).

Interpretation of Claims 14-18

8. Regarding claims 14-18: Due to the ambiguity noted above under 35 USC 101 and 112(1) rejections, the examiner has not applied prior art rejections to claims 14-18.

Specifically, neither the claims, nor the specification, have specifically disclosed the techniques or actual process for realizing the specific embodiment of the claimed elements relating to the tetrahedralization filter comprising a receiver, a processor, and an element subdivider, in either hardware or software. Accordingly, a skilled artisan would be at odds to determine specific embodiment of these claimed elements. (Also see: 101 and 112 rejections and objection to drawings above)

Conclusion

9. *The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Careful consideration should be given prior to applicant's response to this Office Action.*

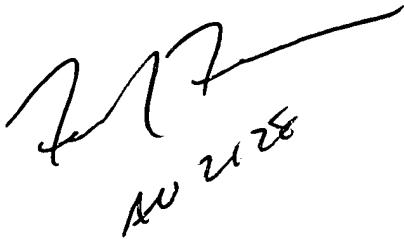
U.S. Patent 6,625,938 issued to Shimada et al teaches subdivision of mesh elements and tetrahedralization.

"Progressive Tetrahedralizations", O.G. Staadt et al, IEEE 0-8186-9176-x/98, IEEE 1998 teaches subdivision of mesh elements and tetrahedralization.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Fred Ferris whose telephone number is 571-272-3778 and whose normal working hours are 8:30am to 5:00pm Monday to Friday. Any inquiry of a general nature relating to the status of this application should be directed to the group receptionist whose telephone number is 571-272-3700. If attempts to reach the

examiner by telephone are unsuccessful, the examiner's supervisor, Jean Homere can be reached at 571-272-3780. The Official Fax Number is: (703) 872-9306

*Fred Ferris, Patent Examiner
Simulation and Emulation, Art Unit 2128
U.S. Patent and Trademark Office
Randolph Building, Room 5D19
401 Dulany Street
Alexandria, VA 22313
Phone: (571-272-3778)
Fred.Ferris@uspto.gov
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A handwritten signature in black ink, appearing to read "F. Ferris". Below the signature, the text "AU 2128" is handwritten.